JAN MCLIN CLAYBERG
PATENT AND TECHNICAL TRANSLATION

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ACCREDITED BY AMERICAN TRANSLATORS ASSOCIATION
• GERMAN AND FRENCH TO ENGLISH
•• ENGLISH TO GERMAN

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DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/DE2003/002466, filed on 07/22/2003, and published on 02/26/2004 under No. WO 2004/017266 A1.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

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Specification

Device and Method for Inspecting Material

The invention relates to an arrangement and a method for inspecting material in accordance with the preamble of claim 1 or 12.

Such arrangements are used, but not exclusively, for inspecting printed sheets imprinted with securities, for example. In this connection, the sheet-shaped material is illuminated by means of an inspection light from the illuminating device, wherein the inspection light is either reflected at the surface of the material (incident light inspections), or shines through the material (transmitted light inspections). The inspection light is subsequently recorded by a sensor device, for example a camera, and the input signals detected in the course of this are evaluated in an evaluating unit.

An arrangement for inspecting sheet-shaped material is known from WO 01/85586 A1. Two illuminating devices and two sensor devices are provided by this arrangement, which are respectively assigned to each other. The first illuminating device is arranged relative to the assigned sensor device in such a way that the inspection light falls through the sheet-shaped material, so that a transmitted light inspection is made possible. But the second illuminating device is arranged relative to the assigned sensor device in such a way that the inspection light from the second illuminating device is reflected at the material, so that an incident light inspection is made possible. As a result it is therefore possible to perform an incident light inspection and a

transmitted light inspection of the material to be inspected.

DE 44 34 168 A1, EP 0 952 438 A2, JP 10-185 690 A and USP 3,120,782 disclose arrangements for inspecting material by means of a sensor device and several light sources, wherein the light sources respectively emit inspection light of different colors of the light.

GB 2 002 923 A and DE 15 12 179 B1 show arrangements of light sources for incident light and transmitted light.

The object of the invention is based on providing an arrangement and a method for inspecting material.

In accordance with the invention, the object is attained by means of the characteristics of claims 1 or 12.

A particular advantage of the invention lies in that only one sensor device is required, for example a color camera, a color line camera or a CCD camera, for being able to check various testing criteria by means of the arrangement. In this case the invention rests on the basic idea that the different testing criteria are checked by means of light of different colors. Therefore the illumination device has at least two light sources, each of which emits inspection light of different light color, i.e. different wave length. At least two different color channels are provided in the sensor device. It is possible by means of this to record light of different colors with the sensor device, which can then be separately evaluated in the evaluation unit. The input signals recorded by the sensor device can be processed separately of each other in accordance with the respective color of light by means of the different color channels so that, in spite of using only one

sensor device, the different testing criteria are not mixed up.

It is particularly advantageous if the light sources emit inspection light of a substantially monochrome light color. These monochrome light colors can be assigned in a simple way to the different color channels of the sensor device, so that an unintentional distortion or influencing of the input signals in the different color channels is essentially prevented.

The spectral position and/or the band width of the inspection light emitted by the light sources is matched to the transmission curve of the sensor device.

Commercially available color cameras, which can be used as sensor devices in the proposed arrangement, customarily have three separate color channels for the colors red, blue and green. It is therefore particularly advantageous if the illuminating device has three light sources, whose inspection light is matched to the respective properties of the three color channels. Three light sources with the monochrome light colors red, blue and green, for example, can be used for this purpose.

The arrangement offers particular advantages if the light sources are arranged in different positions relative to the material. It is possible as a result to check different testing criteria by means of this, which correspond to the respective positions, while only a single sensor device must be provided.

In order to be able to adapt the arrangement to different inspection purposes, it is particularly

advantageous if the light sources are displaceably seated. This means that by displacing the light sources it then becomes possible to adapt the different light sources to different testing criteria.

In accordance with a preferred embodiment, one light source has been arranged in such a way that the inspection light shines through the respective material. Moreover, a second light source has been arranged in such a way that the respective inspection light is reflected by the material. As a result it is possible to achieve by this that by means of the arrangement an incident light inspection, wherein the inspection light is reflected by the material, can be performed simultaneously with a transmitted light inspection, wherein the inspection light falls through the material.

Only one sensor device is required for this combined incident light and transmitted light inspection, because the incident light inspection is processed in a first color channel, and the transmitted light inspection in a second color channel.

Alternatively or in addition to this embodiment it is also possible to arrange two light sources in such a way that the different colored inspection lights are reflected at different angles by the material. With this embodiment, too, the input signals created by the inspection light in the sensor device are processed in different color channels, so that different testing criteria can be recorded and processed with only a single sensor device.

An exemplary embodiment of the invention is represented in the drawings and will be described in greater detail in what follows.

The single drawing figure shows, in a schematic cross section, an arrangement for testing sheet-shaped material.

The arrangement 01 represented in the drawings has a sensor device 02 embodied as a color line camera, three light sources 03, 04, 06, which form an illumination device, and a support 07.

The material 08 to be inspected, in particular a sheet- or web-shaped material 08, is introduced into the arrangement 01 by means of conveying arrangements, not represented, and then lies flat on the top of the support 07. A recess 09 is provided in the support 07, so that inspection light 12 emitted by a light source 06 arranged underneath the support 07 can fall into the lens of the sensor device 02. The light source 03 emits inspection light 10 of the monochrome light color red. The light source 04 emits an inspection light 10 of the monochrome light color blue. The light source 6 emits the inspection light 12 of the monochrome light color green. The sensor device 02 has three separate light channels for the light colors red, blue and green.

The process of the inspection of the image information, in particular the print image, of the material 08 is performed as follows. After the material 08 has been arranged above the recess 09, the light sources 03, 04 and 06 simultaneously emit their respective inspection light 10, 11 and 12 in the different light colors. The red inspection light 10 and the blue inspection light 11 are reflected at different angles at the sheet-shaped material 08 and together fall into the lens of the sensor device 02. As a result it is thus possible to perform an angle-dependent incident light inspection of the sheet-shaped material 08. Simultaneously

the green inspection light 12 emitted by the light source 06 falls through the sheet-shaped material 08 and also into the lens of the sensor device 02. In this way it is possible simultaneously with the two incident light inspections by means of the light colors red and blue to perform a separate transmitted light inspection by means of the light color green. The assignment of the different light colors to the different incident light and transmitted light inspections is basically arbitrary and can be interchanged.

The inspection lights 10, 11 and 12 corresponding to the different light colors red, blue and green are processed in the sensor device 02 in separate color channels and are passed on to an evaluating device, not represented. Therefore the image contents of the individual color channels can be processed separately of each other in the evaluation unit. However, it is of course also possible here to bring the input signals received on the separate color channels into correlation with each other in order to be able, for example, to draw spatial conclusions.

List of Reference Numerals

01	Arrangement
02	Sensor device
03	Light source
04	Light source
05	-
06	Light source
07	Support
08	Material, sheet-shaped
09	Recess
10	Inspection light, red
11	Inspection light, blue
12	Inspection light, green